Beneficial Insects Laboratory
Annual Report of Activities
2001-2002

The hemlock woolly adelgid, *Adelges tsugae* and coccinellid, *Sasajiscymnus tsugae* on eastern hemlock. Photos-Kathleen Kidd

North Carolina Department of Agriculture
& Consumer Services

2001-2002 REPORT OF ACTIVITIES

Beneficial Insects Laboratory
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Introduction

This report is a summary of the projects undertaken by the Beneficial Insects Laboratory (BIL) of the Plant Industry Division of the North Carolina Department of Agriculture and Consumer Services during the years 2001 and 2002. The BIL addresses two programs, biological control and apiary inspection. The Biocontrol program implements classical biological control projects, in which the natural enemies of pest insects and weeds are released in the environment with the goal of stabilizing pest populations below their economic threshold. The Apiary Inspection program is designed to maintain a viable bee and honey industry in North Carolina through inspection for mites, diseases, and other hive pests.

The insects featured on our cover this year are the hemlock woolly adelgid, and a small predaceous beetle that feeds on the adelgids. *Adelges tsugae* Annand, (Homoptera: Adelgidae) is native to Asia and a pest of hemlock trees (*Tsuga* spp.). The predator *Sasajiscymnus tsugae* (Sasaji & McClure) (Coleoptera: Coccinellidae) is also native to Asia and preys only on adelgids. The pest has devastated the hemlock forests of the northeastern US, and biological control seems the only practical solution to save natural stands of the tree. To this end, and in cooperation with the USDA Forest Service and USDA-APHIS, we initiated a program to mass rear the beetle in 2002.

USDA-APHIS, ARS, and Forest Service, as well as the Cooperative Extension Service, faculty, and staff of North Carolina State University all played roles in the implementation of our programs during 2001-2002. We are grateful for the cooperation of other members of the NCDA Plant Protection Staff, including Support Services, and the statewide field staff under the supervision of Dan Wall, Mike Massey, and Logan Williams.

Implementation of our 2001-2002 programs included release of a total of 6708 beneficial insects; some were redistributions within the state, others originated from out-of-state. Cooperative work with USDA-APHIS for cereal leaf beetle continued, as well as studies on the biology of the adventive predator *Harmonia axyridis*.

The Quarantine Facility housed at the laboratory has been used by our personnel, entomologists from NCSU, and by the Museum of Natural Sciences. Rebecca Fergus currently serves as the Quarantine Officer, and welcomes inquiries about the facility.

Three papers were published by BIL personnel during 2001-2002:

Kidd, K.A. and D.B. Orr. 2001. Comparative feeding and development of *Pseudoplusia includens* (Lepidoptera: Noctuidae) on kudzu and soybean foliage. Ann. Entomol. Soc. Amer. 94: 219-225.

Meyer, J.R., C.A. Nalepa and C. Devorshak. 2001. A new species of *Anicetus* (Hymenoptera: Encyrtidae) parasitizing terrapin scale [*Mesolecanium nigrofasciatum* (Pergande)]. Fla. Entomol. 84(4): 686-690.

Nalepa, C.A. and K.A. Kidd. 2002. Parasitism of the multicolored Asian lady beetle (Coleoptera: Coccinellidae) by *Strongygaster triangulifer* (Diptera: Tachinidae) in North Carolina. J. Entomol. Sci. 37(1): 124-127 (reproduced here with the permission of the editor).

The personnel of the BIL during 2001-2002 were:

Dr. Kathleen Kidd, Biological Control Administrator
Dr. Christine Nalepa, Laboratory Research Specialist
Dr. Kenneth R. Ahlstrom, Taxonomist
Ms Rebecca Romano Fergus, Ag. Res. Tech II & Quarantine Officer
Ms Jamie Meadows, Office Assistant
Ms Carolyn Rhame, Office Assistant
Ms Anne Burroughs, Ag. Res. Technician
Ms Karin Hess, Ag. Res. Technician
Ms Jessica Bridges, Ag. Res. Technician
Ms Jennifer Keller, Ag. Res. Technician

Mr. Donald Hopkins, State Apiarist and Apiary Inspection Supervisor
Mr. Glenn Hackney, Agricultural Research Technician
Mr. Will Hicks, North Central Piedmont Area Apiary Inspector
Mr. Adolphus Leonard, Eastern Area Apiary Inspector
Mr. William Sheppard, Sandhills Area Apiary Inspector
Mr. Richard Lippard, Western Piedmont Area Apiary Inspector
Mr. Jack Hanel, Mountain Area Apiary Inspector

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R.R. Fergus, K.A. Kidd, and C.A. Nalepa
Editors
28–II-03

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Records of Beneficials Released during 2001-2002

DATE	HOST	BENEFICIAL	#	SOURCE	RELEASE LOCATION
4/2001	Thistle	*Trichosirocalus horridus*	35	Coley Farm, Nash Co	Buncombe Co.
4/2001	Thistle	*Rhinocyllus conicus*	420	Coley Farm, Nash Co	Buncombe Co.
4/2001	Thistle	*Rhinocyllus conicus*	900	Coley Farm, Nash Co	Ashe Co.
4/2002	CLB*	*Tetrastichus julis*	1755	Piedmont Res. Sta..	Moore Co.
5/2002	CLB	*Tetrastichus julis*	1181	Piedmont Res. Sta.	Randolph Co.
5/2002	CLB	*Diaparsis temporalis*	38	Piedmont Res. Sta.	Randolph Co.
6/2002	Fire Ant	*Pseudacteon tricuspis*	2973	USDA-ARS, Gainesville, FL	Duplin Co.

*CLB = Cereal leaf beetle, *Oulema melanopus*

TOTAL: A total of 6,708 insects were released in North Carolina during 2001-2002: five species of natural enemies onto three hosts.

NCDA & CS Beneficial Insects Laboratory
Summary of Quarantine Activities 2001-2002

A total of 19 shipments of foreign material were received by the NCDA & CS Insect Quarantine Facility during 2001 and 2002, and one shipment from previous years remained in the facility.

ID #	SPECIES	FAMILY	STAGE	#	ORIGIN	STATUS
Q01-1	***Lymantria dispar***	Lymantriidae	Larvae	126	NC	Insects dissected with some held in incubator
Q02-1	***Lymantria dispar***	Lymantriidae	Larvae	198	NC	Insects dissected with some held in incubator
Q01-2	***Aethina tumida***	Nitidulidae	Adults	10	NC	Colony being maintained in quarantine for research.
Q01-3	***Aethina tumida***	Nitidulidae	Larvae	350	NC	Colony being maintained in quarantine for research.
Q02-2	***Aethina tumida***	Nitidulidae	Adults	80	NC	Colony being maintained in quarantine for research.
Q02-3	***Aethina tumida***	Nitidulidae	Larvae	440	NC	Colony did not survive
Q99-1	***Calidiellum rufipenne***	Cerambycidae	Pupae/ larvae/ adults	Unknown 17 emerged to date	NC	Cedar logs being held in quarantine for maturation and emergence of adult beetles.

Ash Whitefly: *Encarsia inaron*

Rebecca Romano Fergus

Originating in Europe and North and Central Africa, the ash whitefly (AWF), (S*iphoninus phillyreae* Haliday)(Homoptera:Aleyrodidae) first appeared in the United States in California in 1988. By 1993, the AWF was seen throughout Wake County in North Carolina on Bradford pear trees (*Prunus calleryana* 'Bradford'). A parasitic wasp, *Encarsia inaron* (Walker) (Hymenoptera: Aphelinidae), that successfully controlled the AWF in California was released in Wake County during 1994-1995. The parasitoid has become established and spread throughout the county.

Since studies in past years indicated that AWF is established in Wake County, our new goal is to find out where AWF has spread across North Carolina. In 2002, Bradford Pear leaves were sampled in outlying areas of Wake County and also in Johnston, Durham and Sampson counties. AWF presence was found in all areas except Sampson County. In 2003, we hope to do more sampling that will show us the actual extent of AWF in North Carolina.

Cereal Leaf Beetle Parasitoid Insectary Program

K.A. Kidd

The cereal leaf beetle (*Oulema melanopus* (L.)) (CLB) (Coleoptera: Chrysomelidae) is native to the Palearctic region and a pest of small grains. This species was first detected in North Carolina in 1977 in 19 counties, primarily along the Virginia border, and is now found in all grain-growing regions of the state. CLB can cause severe damage to the leaves of wheat, oats, barley and other cereal crops, and when heavy feeding occurs, grain yields may be reduced.

Cereal leaf beetle was discovered in Michigan in the early 1960s, and efforts to quarantine and eradicate it were unsuccessful at that time. A biological control program was initiated in 1963 (Haynes and Gage 1981) and parasitoids were collected in Europe. Parasitoid nurseries (or field insectaries) were established in Michigan and other midwestern states by the late 1960s; field days were held to distribute parasitoids to regional extension personnel and farmers. USDA originally imported one species of egg parasitoid and three species of larval parasitoids from Europe. These became established in the United States, and all have been released in North Carolina. *Anaphes flavipes* (Foerster) (Hymenoptera: Mymaridae) (the egg parasitoid) was released as early as 1978. This species disperses well and has spread across NC. Three larval parasitoids, *Tetrastichus julis* (Walker) (Hymenoptera: Eulophidae), *Diaparsis temporalis* Horstmann (Hymenoptera: Ichneumonidae) and *Lemophagus curtus* Townes (Hymenoptera: Ichneumonidae) have also been released.

The first parasitoid releases were made in North Carolina in 1978, and a field insectary program, similar to the program in Michigan, was started in the fall of 1987; insectaries were seeded with parasitized larvae from an insectary in Virginia. Insectaries have been established at the Oxford Research Station near Oxford, the Piedmont Research Station near Salisbury, and the Tidewater Research Station near Plymouth, but the Piedmont insectary is the only one that has had perennial populations of CLB and *Tetrastichus julis*. Adults of *Diaparsis temporalis* (~420), emerged from material collected in Europe, were released at the Piedmont insectary in 1996 and 1998. Larval ichneumonids, likely *L. curtus* were found parasitizing CLB larvae at Salisbury in 2000. CLB larvae parasitized by all three species were released at Tidewater in 1994, and approximately 400 adult *D. temporalis* adults were released there in 1995. *Tetrastichus julis* was recovered in low numbers at Tidewater in 1998, but neither of the ichneumonid species has been found at that location. The insectary was discontinued at Tidewater in 1999 due to low CLB populations. CLB populations are low at Oxford, and low numbers of *T. julis* are typically recovered there. The egg parasitoid is prevalent at both insectaries, but does not appear until late in the season.

Dissection of a sample of larvae is the most accurate means of determining parasitism, but is not always practical in the field. The Piedmont insectary is over 2 ½ hours from our lab, so it is desirable to be able to predict the best time to collect larvae for redistribution. Degree-day models may provide a means to predict emergence of both host and parasites. Using a base temperature of 48°F (the threshold for development of CLB and *T. julis*) Gage and Haynes (1975) reported that about 50% of the first generation *T. julis* adults emerged from oat stubble by 550 DD_{48}, and the second generation by 1100 DD_{48}. Miller (1977) determined that *D. temporalis* requires about 550 DD_{48}.

Materials and Methods

Descriptions of the parasitoid insectaries may be found in previous reports (Kidd and Bryan 1993, 1994). The Piedmont insectary consists of two plots, each divided into four or more subplots. The Oxford insectary consists of four plots, with two planted each year alternating with two fallow plots. Both insectaries have fall wheat in two subplots followed by one or more spring planting of oats in adjacent subplots. No-till planting methods are used in all plots.

A simple method of calculating degree-days (DD) was tested to determine optimum times to sample for CLB and its natural enemies. Average daily temperature, as reported by the research stations (http://www.nc-climate.ncsu.edu/agnet/), was entered into a spreadsheet beginning 1 January of each year, and a base temperature of 48°F was subtracted. Negative values were deleted, and positive values were summed to obtain accumulated DD_{48}. Degree-day values were compared to the presence of parasitoids in CLB larvae to validate using this method as a means to more efficiently determine when to sample.

Beginning in April, insectaries were monitored every 7-11 days. Presence of CLB adults in the early spring was determined using sweep net samples. After eggs and larvae were detected, the presence of adults was noted during visual inspection of the plants. To determine population densities of the eggs and larvae, three samples of one square foot each were taken in each subplot. Each sample consisted of counts of all eggs and larvae on 20.5 inches of small grain row (7-inch row spacing). After larvae were detected in the field, these were removed and examined for the presence of parasitoids. K.R. Ahlstrom, NCDA & CS, Plant Industry taxonomist, dissected larvae to determine the presence of parasitoid eggs or larvae at the Beneficial Insect Lab.

Results and Discussion

During 2001 and 2002, populations of cereal leaf beetle were low at the Oxford insectary, and the density of eggs and larvae never exceeded $1.0/ft^2$. Populations were high at the Piedmont insectary in 2001 and 2002 (Table 1). Highest larval populations occurred 3 May in the first oat plantings. In 2001, eggs were deposited and hatched over a short period of time, rather than oviposition and subsequent egg hatch extending over several weeks. Typically, eggs occurring in May are susceptible to attack by *A. flavipes*, but few eggs occurred at that time and no parasites were found in 2001. In 2002, 300 parasitized eggs were collected and sent to the USDA National Biological Control Lab in Niles, MI, for their program.

Three species of larval parasitoids were found in 2001 at the Piedmont insectary, but only two, *T. julis* and *D. temporalis*, were found in 2002 (Table 2). No larvae were removed from the insectary in 2001 to allow parasitoid numbers to increase, but in 2002, over 1500 larvae were harvested and distributed to growers in Moore and Randolph Co., NC

The degree-day method did not prove useful in predicting levels of parasitism. Data in this study do not represent emergence of parasitoids, but the percentage of the CLB population that has been attacked, and the relationship between the two is not clear. Ellis et al. (1978) noted that *T. julis* is effective at low host densities. Therefore, when populations of CLB are low at the beginning and end of the season (ca. 15 April and 15 May), an individual larva is more likely to be attacked by *T. julis* than when populations are high. Gage and Haynes (1975) demonstrated that *T. julis* emerges prior to the appearance of CLB larvae, and is present when CLB larvae hatch. The later generation of *T. julis* does not emerge until the majority of larvae have completed their development. The degree-day model may not be a good predictor of levels of *T. julis* parasitism. Further data may be needed to determine its usefulness for predicting ichneumonid parasitism, but degree-days are useful in determining when to begin sampling for CLB larvae in the spring.

Acknowledgements

Numerous individuals contributed to this project, and the list includes, but is not limited to Raymond Coltrain, Ray Horton, Bill Clements, Research Stations and Rebecca Fergus, NCDA&CS, Beneficial Insect Lab.

References

Ellis, C.R., D.G. Harcourt, and D. Dubois-Martin. 1978. The current status in Ontario of *Tetrastichus julis* (Hymenoptera: Eulophidae), a parasitoid of the cereal leaf beetle. Proc. Entomol. Soc. Ontario. 109: 23-26.

Gage, S.H. and D.L. Haynes. 1975. Emergence under natural and manipulated conditions of *Tetrastichus julis*, an introduced larval parasite of the cereal leaf beetle, with reference to regional population management. Environ. Entomol. 4: 425-434.

Haynes, D.L. and S.H. Gage. 1981. The cereal leaf beetle in North America. Ann. Rev. Entomol. 26: 259-287.

Kidd, K.A. 1996. Cereal leaf beetle biological control in North Carolina. NCDA BioControl Laboratory Report of Activities. pp 11-16.

Kidd, K.A. and M.D. Bryan. 1993. Cereal leaf beetle parasitoid insectary program. NCDA BioControl Laboratory Report of Activities. pp 11-19.

Kidd, K.A. and M.D. Bryan. 1994. Cereal leaf beetle parasitoid insectary program. NCDA BioControl Laboratory Report of Activities. pp 10-19.

Miller, D.J. 1977. The bionomics of *Diaparsis* n. sp. (Hymenoptera: Ichneumonidae) a larval parasitoid of the cereal leaf beetle, *Oulema melanopus* (L.) (Coleoptera: Chrysomelidae). P.M. Tech. Report 12. 165 pp. Michigan State University.

Tetrastichus julis and CLB Larva

Table 1. Cereal Leaf Beetle Populations, Piedmont Research Station.

2001	Eggs (Mean #/ft^2)			Larvae (Mean #/ft^2)		
Date	Wheat	Oats1	Oats2	Wheat	Oats1	Oats2
9 April	2.3	24.5	5.8	0.3	0.2	0.0
16 April	4.0	22.5	12.2	4.8	8.2	2.0
27 April	6.3	5.5	6.7	14.5	21.7	6.7
3 May	0.0	0.8	1.5	8.0	28.3	7.8
9 May	0.0	0.8	1.0	5.5	13.0	9.2
15 May	0.0	0.2	1.0	4.8	8.5	1.7
24 May	0.0	0.0	0.0	0.0	0.0	0.0

2002	Eggs (Mean #/ft^2)			Larvae (Mean #/ft^2)		
Date	Wheat	Oats1	Oats2	Wheat	Oats1	Oats2
15 April	2.2	18.0	11.7	17.5	0.7	0.0
24 April	0.2	4.0	10.3	18.8	27.0	6.3
3 May	0.0	1.5	3.8	6.0	34.7	8.3
9 May	0.0	1.8	0.7	0.8	16.3	6.0
15 May	0.0	0.2	0.0	0.0	0.3	0.5
22 May	0.0	0.2	0.0	0.0	0.0	0.0

Table 2. Cereal Leaf Beetle Parasitism, Piedmont Research Station, Salisbury.

2001

Date	DD_{48}	Planting	n	% Parasitism (Mean # parasitoids/larva)		
				T. julis	*D. temporalis*	*L. curtus*
9 April[1]	242.7	All	0			
16 April	373.2	Wheat	29	62.0%	0.0%	0.0%
		Oats 1	12	75.0	0.0	0.0
		Oats 2	2	0.0	0.0	0.0
27 April	477.2	Wheat	73	50.7	2.7	0.0
		Oats 1	75	49.3	2.6	1.3
		Oats 2	44	47.7	11.4	2.7
3 May	557.8[2]	Wheat	76	14.5	0.0	0.0
		Oats 1	79	20.3	0.0	2.5
		Oats 2	73	20.5	0.0	0.0
9 May	--	Wheat	50	0.1	0.0	0.0
		Oats 1	63	3.2	4.8	3.2
		Oats 2	45	6.7	0.0	0.0
15 May	--	Wheat	53	9.4	0.0	0.0
		Oats 1	57	10.5	0.0	7.0
		Oats 2	53	5.7	1.9	1.9

[1]No larvae collected due to low numbers present.
[2]Temperature values missing after 2 May. Value shown is for 2 May.

Table 2. Continued.

2002

Date	DD_{48}	Planting	n	% Parasitism (Mean # parasitoids/larva) *T. julis*	*D. temporalis*	*L. curtus*
15 April	353.2	Wheat	51	37.3%	0.0%	0.0%
		Oats 1	18	26.8	0.0	0.0
		Oats 2	0[1]			
24 April	554.8	Wheat	56	26.8	0.0	0.0
		Oats 1	51	11.8	0.0	0.0
		Oats 2	59	8.5	0.0	0.0
3 May	711.6	Wheat	50	0.0	0.0	0.0
		Oats 1	54	22.2	7.4	0.0
		Oats 2	51	33.3	17.6	0.0
9 May	817.0	Wheat	6	0.0	0.0	0.0
		Oats 1	54	22.2	7.4	0.0
		Oats 2	51	33.3	17.6	0.0
15 May	921.6	Wheat	0[1]			
		Oats 1	52	74.6	15.4	0.0
		Oats 2	59	83.1	16.9	0.0
22 May	995.6	All	0[1]			

[1]No larvae collected due to low numbers present.

The multicolored Asian Lady Beetle *Harmonia axyidis*

C. A. Nalepa

In October and November of 2001, we collected the imported lady beetle *Harmonia axyridis* (Pallas) from two locations: Revis home, Reems Creek Rd., Buncombe Co., and the grounds of the Beneficial Insect Laboratory in Cary, Wake Co. The insects were collected as they arrived at aggregation sites, then used in a series of laboratory experiments conducted in the Phytotron of North Carolina State University. The objective of these studies was to establish baseline conditions for future behavioral research on the cues used by beetles when settling into overwintering quarters. During the flight period, a series of field experiments were conducted in Asheville and Cary to determine the visual cues used by *Harmonia* when landing at aggregation sites.

We planned to continue these studies during the autumn of 2002; however, our plans were thwarted by one of the vagaries of working with insects. Because the weather got cold (and stayed cold) prior to flight initiation in the beetles, we had few experimental subjects. There were just three minor flights in the Cary area. We were able to collect enough beetles for preliminary trials, and obtained enough information to know that our experimental designs will work. We are currently analyzing the preliminary data and refining the setup for next year.

Gypsy Moth: *Entomophaga maimaiga*

Rebecca Romano Fergus

The gypsy moth *(Lymantria dispar* Linnaeus) was brought into the United States in 1869 in an attempt to start a silkworm industry. Soon after, gypsy moth escaped and has since become a major forest pest in portions of the U.S. North Carolina has battled the gypsy moth since the early 1970's. The first insecticide treatment of gypsy moth in NC took place in 1974 on about 350 acres in Winston-Salem. Since 1982, all of NC has been survey trapped and the first quarantine was imposed on eastern NC in 1988. Currently, the quarantine extends through all of Currituck County and those portions of Dare County located on the Outer Banks.

In 1989, an entomopathogenic fungus native to Japan, *Entomophaga maimaiga* caused considerable mortality of gypsy moth in the Northeast US. Over the next few years, introductions of *Entomophaga maimaiga* into new areas resulted in successful epizootics. Therefore, in 1992 the NCDA & CS decided to introduce *Entomophaga maimaiga* into gypsy moth populations established in eastern North Carolina.

Soil containing *Entomophaga maimaiga* resting spores was collected in New Jersey and transported to NC. A site in Camden County was chosen for the first release and was a low-lying area with an ongoing gypsy moth infestation. The site had been treated twice with *B.t. (Bacillus thuringiensis)* without significant reduction in gypsy moth populations. Beginning in mid-May of each survey year, larvae were collected at release sites and held for ten days in individual cups containing artificial diet to determine establishment of *Entomophaga maimaiga*. At the end of that period, any larvae remaining alive were autoclaved. Dead larvae were dissected and a sample of hemolymph was examined with a phase contrast microscope for the presence of resting spores and conidia.

In 1993, field-collected larvae were sampled and dissected with one being infected with *Entomophaga maimaiga*. In 1996, soil contaminated with resting spores was collected from Virginia and distributed at 11 gypsy moth sites in Dare, Currituck and Camden Counties. Larvae infected with the fungus rose significantly in the following years: 6% in 1997, 21% in 1998, 30% in 1999 and 51% in 2000. As rainfall was significantly decreased in the springs of 2001 and 2002, the percentage infected dropped, with 9.5% in 2001 and 9.6% in 2002. Also, a factor in this drop could be that different sites were being sampled, as in some from past years, the forests were clear-cut. Dissections will continue, as we plan to collect larvae spring of 2003.

Red Imported Fire Ants:
Release of *Pseudacteon tricuspis* (Diptera: Phoridae)

Rebecca Romano Fergus

The red imported fire ant (*Solenopsis invicta* Buren) (RIFA) inhabits over one third of North Carolina and almost the entire Southeastern United States (Callcott and Collins 1996). The RIFA is native to South America, where RIFA populations are one fifth of those normally found in North America (Porter et al. 1997). These population differences are attributed in part to the RIFA escaping natural enemies in their native habitat. One such enemy is the phorid fly *(Pseudacteon tricuspis* Borgmeier), a parasitic insect that preys upon only the fire ant. Using their hypodermic shaped ovipositor, female phorids inject a single egg into the neck of a foraging RIFA. Just after hatching, the larva moves into the RIFA's head where for two to three weeks it will develop (Porter *et al.* 1995). Just before pupation, the larva releases an enzyme that dissolves the membranes that hold the exoskeleton together. The parasitoid consumes the contents of the ant's head, resulting in decapitation of the ant. Pupation occurs in the head and two to three weeks are required until the adult fly emerges. About six hours after emergence, phorids mate and begin oviposition.

Researchers with USDA-ARS imported *P. tricuspis* and began rearing it at their Gainseville, FL lab. First releases and establishment were in 1997 in Gainesville with evidence of natural dispersal from release sites (Porter et al. 2001). The goal of this release program is not to eradicate the RIFA, but to reduce their populations and allow the native ants to better compete with them. When flies emerge, the RIFA becomes aware of their presence and they decrease their foraging. This can result in smaller mounds per acre because of a smaller food supply. Consequently, this allows the native ants to acquire more food than before the RIFAs were threatened by the phorid.

In May 2000, the NCDA & CS became partners with USDA-ARS to release phorid flies at a site in Beaufort County. A total of five generations were recovered before temperatures dropped too low (< 70°F) for flies to be observed. Monitoring efforts resumed in spring 2001 and spring 2002 with no phorid activity observed. It is hypothesized that the flies still inhabit this area, but possibly in low numbers. We will continue to monitor this site in 2003.

In June 2002, we received another shipment of phorid flies from USDA-ARS and a site in Duplin County was chosen for their release. Almost 3000 flies were released between June 3 and June 14, 2002. Monitoring efforts proved successful with the first generation of flies found on July 5 at 32 days after the initial release date. Four more generations of phorids were observed before the end of the warm weather, with the last and fifth generation seen on November 10. Monitoring will resume in spring 2003 or as the daytime temperature approaches 70°.

References Cited

Callcott, A. A. and H. L. Collins. 1996. Invasion and range expansion of imported fire ants (Hymenoptera: Formicidae) in North America from 1918-1995. Fla. Entomol. 79: 240-251.

Porter, S. D., M. A. Pesquero, S. Campiolo, and H. G. Fowler. 1995. Growth and development of *Pseudacteon* phorid fly maggots. (Diptera: Phoridae) in the heads of *Solenopsis* fire ant workers. Environ. Entomol. 24: 475-479.

Porter, S. D., D. F. Williams, R. S. Patterson, and H. G. Fowler. 1997. Intercontinental differences in the abundance of *Solenopsis* fire ants: an escape from natural enemies? Environ. Entomol. 26: 373-384.

Porter, S. D., L. Noguiero D. E. Sa, and L. Morrison. 2001. Establishment and dispersal of the fire ant decapitating fly *Pseudacteon tricuspis* in Northern Florida. Biological Control. http://nps.ars.usda.gov/publications/publications.htm?SEQ_NO_115=129805

Red Imported Fire Ants: Monitoring Release Sites of the Microsporidian *Thelohania solenopsae*

C. A. Nalepa

The monitoring of two plots (one treatment, one control) in Garland (Sampson Co.) where the microsporidian disease (*Thelohania solenopsae*) of red imported fire ant was released in cooperation with the USDA in 1998 and 2000 was continued during 2001. The control and treatment plots were each surveyed twice (20 April and 11 July 2001). During each visit all mounds in each plot were mapped and sampled for workers. Brood samples were also taken from mounds in which the disease was released, and the population of ants in each mound estimated. Larval smears and workers were shipped to Dr. David Oi (USDA-ARS, Gainesville), who examined them for the presence of the disease. No evidence of infection could be found. We mutually agreed to terminate the study in North Carolina pending further research on effective techniques for inoculating and establishing the disease in the Southeastern United States.

Identification Services

K. R. Ahlstrom

Identifications of insects and other arthropods were provided for a variety of individuals and organizations during 2001-2002. Approximately 400 identifications were provided for Plant Industry personnel, including boll weevil, sweetpotato weevil, gypsy moth, red imported fire ant, maggots of the Mediterranean fruit fly, cereal leaf beetle parasitoids, and various other biological specimens including spiders. Nearly 300 identifications were made for USDA inspectors as part of the exotic bark beetle trapping program for CAPS. In addition, 36 *Tiphia* wasps imported from China into the USDA's Introduction Laboratory in New Jersey were identified as part of the USDA Japanese Beetle Biological Control Program. A total of 600 identifications were made of insect pest material provided by local pest control operators, primarily from home and business inspections. Other miscellaneous identifications were made for entomology students at NCSU, and approximately 25 identifications were made for several people around the United States, who sent electronic photographs over the Internet after accessing the identification service via the NCDA & CS Plant Industry website.

Hemlock Woolly Adelgid

K.A. Kidd

The hemlock woolly adelgid, *Adelges tsugae*, (HWA) a pest of hemlocks, is native to Asia. The insect was first found in the US in 1924, but its spread was slow until it reached areas where hemlock is endemic. Upon reaching large, natural stands of hemlock, the insect increased rapidly and was spread by birds and the movement of nursery stock, in addition to natural dispersal. Infestations are now found from Georgia to New Hampshire. The first infestations in NC were recorded in 1995 in two counties, and currently, at least 25 counties are infested. After foreign exploration in Japan, the center of origin for the HWA, several natural enemies were identified, and a small coccinellid, *Sasajiscymnus* (=*Pseudoscymnus*) *tsugae* (Sasaji and McClure) has now been reared and released as a biological control agent. As HWA infestations became more widespread, the need to rear additional beetles became acute, so a cooperative agreement between NCDA&CS Beneficial Insect Lab, the USDA-Forest Service, and USDA-APHIS was established to begin rearing beetles in NC.

Current Status of Program: The HWA rearing lab was constructed in space recently vacated by another agency at the Beneficial Insect Lab in Cary, NC. Four part-time Agricultural Research Technicians were hired to work on the project and include Jessica Bridges, Anne Burroughs, Karin Hess, and Jennifer Keller. Extensive cleaning and painting were required, and 18 cages, 24” X 24” X 19” were constructed of plexiglass. Timers were installed to control light switches. To further “fine-tune” the facility, hemlock boughs infested with adelgid were set up in a cage and conditions monitored. After the lab was prepared, two technicians traveled to the Philip Alampi Biological Control Lab of the New Jersey Department of Agriculture for training on the rearing of *Sasajiscymnus* and HWA. Adult *Sasajiscymnus* were transported back to NC, but a large ice storm shut down power at the lab, dropping the temperature into the 50’s, and oviposition jars could not be set up for several days. Low humidity remains a concern, but several methods are being tested to increase it.

Future Plans: Plans call for rearing about 50,000 beetles. NC and USDA Forest Service will determine strategic release sites. Sites will be monitored for establishment and effect on HWA.

Apiary Inspection Program

D. I. Hopkins and G. D. Hackney

The apiary inspection service monitors bee pests and regulates the movement of bees and equipment to protect the bee and honey industry of North Carolina. Using funds provided in an expansion budget, a laboratory was established in 1998 to perform quality assurance testing for the program. This laboratory is used to confirm mite and disease diagnoses and test equipment that has been fumigated in ethylene oxide chambers. The same expansion funds provided an additional inspector who currently serves the north central piedmont.

A new pest of honey bees and hive products was detected in NC in the fall of 1998. The small hive beetle *Aethina tumida*, of South African origin, was found in Scotland County in November. Earlier in 1998, the pest was found in Florida, Georgia and South Carolina. The initial infestation can be presumed to have been between Charleston, SC and Savannah, GA. Since its initial discovery in Scotland and adjoining counties in November 1998, the beetles have been found to spread to a large number of counties over the last four years.

In-hive treatments with Check-Mite™ strips and ground treatments with Guard Star™ have been used to control the beetles in these yards, but eradication of the beetle has not occurred. Hive and ground treatments were used at infested sites to curtail damage.

To better determine the natural migratory behavior of the beetle, the Apiary Inspection Service has purchased 50 nuc boxes (miniature hives) to be used as bait monitoring stations. Some of these hives were placed within four miles of a known infestation. During the ensuing season these colonies were inspected regularly and thus far no beetles have been found in them.

In an effort to protect the beekeeping industry in NC, NCDA & CS in May 2000 issued an emergency quarantine of the small hive beetle. Areas under quarantine change as surveys indicate the extent to which the beetle has spread. The results of this action and other control measures have been variable across the state. Work continues in monitoring and limiting the spread of this pest.

Other pests, including mites and diseases, continue to be of concern to NC beekeepers. Apiary inspectors assist beekeepers through inspection, treatment, and education. The inspectors take part in educational activities presented at the North Carolina State Beekeepers Association meetings that are held twice a year. There are forty county associations that hold meetings approximately once a month at which the inspectors are frequently invited to speak. These educational endeavors have become a significant portion of the inspectors' duties. With continued cooperation of the beekeepers and the NCDA & CS Apiary Inspection Service, the industry will remain strong and a valuable part of NC agriculture.